Rhode Island
Renewable Energy Growth Program:

Research & Derivation of Initial 2016 Ceiling Price Recommendations

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Overview: Context

- Purpose: To discuss the development of Ceiling Price inputs and recommendations for the 2016 Renewable Energy Growth (REG) Program.
  - DG Standard Contracts Pilot Program: 2011 – 2014 (40 MW)
  - DG Renewable Energy Growth Program: 2015 – 2019 (160 MW)

- Ceiling Price categories are expanded:
  - Technology perspective: Wind III (3 – 5 MW, modeled @ 4.95 MW)
  - Ownership perspective: Not-for-Profit and Affordable Housing → intending to address the net cost impact of an inability to use Federal tax incentives

- Ceiling Prices will be evaluated through an iterative, public process.

- MW Allocation evaluated and proposed by DG Standard Contracts Board through a separate, parallel process.

Overview: Ceiling Price Categories

Eligible Technology	System Size for CP Development	Eligible System Size Range	Tariff Length
Small Solar I*	5 kW	1 to 10 kW	15 and 20 Years Options
Small Solar I, Non-Profit Property & Affordable Housing+	*5 kW*	*1 to 10 kW*	*15 and 20 Years Options*
Small Solar II	25 kW	11 to 25 kW	20 Years
Small Solar II, Non-Profit Property & Affordable Housing+	*25 kW*	*11 to 25 kW*	*20 Years*
Medium Solar	140 kW	26 to 250 kW	20 Years
Medium Solar, Affordable Housing+	*140 kW*	*26 to 250 kW*	*20 Years*
Commercial Solar	500 kW	251 to 999 kW	20 Years
Large Solar	2.0 MW	1 to 5 MW	20 Years
Wind I	1.65 MW	1 to 2.99 MW	20 Years
Wind II	3.3 MW	3 to 5 MW	20 Years
Wind III+	*4.95 MW*	*3 to 5 MW*	*20 Years*
Anaerobic Digestion I	325 kW	150 to 500 kW	20 Years
Anaerobic Digestion II	750 kW	501 kW to 1 MW	20 Years
Small Scale Hydropower I	150 kW	10 to 250 kW	20 Years
Small Scale Hydropower II	500 kW	251 to 1 MW	20 Years

* Small Solar I will be used to evaluate both residential and small business installations. Residential installations will be evaluated under both homeowner and third-party ownership scenarios.

+ New category for 2016 REG

Overview: Derivation of CP Inputs

- Data request
  - Direct stakeholder input
  - Data request follow-up
- Supplemental research (SEA, MCG & MEI)
  - 3rd party, northeast regional cost and performance databases
  - Technology-specific, competitively bid long-term contract pricing in regional markets
  - Interviews (ongoing)
- DG Standard Contracts bid data (2011 – 2014)
- *Renewable Energy Growth Program bid data (2015)*
  - *(expected)*

RESPONSES TO DATA REQUEST

Response to Data Request

- Issued July 10, 2015; responses due August 3, 2015
- Four (4) responses received:
- **Solar**
  - Two (2) responses, which provided one (1) response with selected data points for a 140 kW system, two (2) responses with selected data points for a 500 kW commercial system, and two (2) responses with selected data points for a 1.5 MW system.
- **Wind**
  - One (1) response, which provided selected data for a 1.65 MW system, a 3.3 MW system, and a 4.95 MW system.
- **Anaerobic Digestion**
  - One (1) response, which provided selected data points for a 750 kW system
- **Small Scale Hydropower**
  - No responses were received.

Summary of Response* to Data Request:
Medium Solar (26 to 250 kW)

**An empty cell represents the absence of a data response.*

	Medium Solar	
	2015 Input	Response (1)
	140 kW	140 kW
Production & Cost		
Expected Annual Average Net capacity factor, (%)	13.45%	13.75%
Total Project Cost ($/kW$_{DC}$), excluding Interconnection Cost	$3,274	$3,100
Interconnection cost ($/kW)	$31	$18
O&M expenses ($/kWDC-yr), Yr 1 (excluding those listed below)	$15	$15
Insurance, Yr 1, (provide as % of total project cost, or in $/yr)	0.25%	0.27%
Project Management, Yr 1 ($/yr)	$500	$700
Land Lease, Yr 1 ($/yr)	-	$5,000 fixed
Annual average escalation rate for O&M expenses (%)	2%	3%
Property Tax, Starting Basis	80.00%	80.00%
Property Tax, Annual Adjustment	-5.00%	-5.00%
Property Tax, Basis Floor	30.00%	30.00%
Decommissioning Reserve? If yes, how much?	$0	$0
Inverter Replacement Year		20
Inverter Replacement, $/kW in year replaced	$0	$150
Permanent Financing		
Debt/Equity (D/E) ratio	50%/50%	55%/45%
Debt term (years)	18	15
Interest rate on debt (%)	6.5%	6.50%
Min. Debt Service Coverage Ratio	1.00	1.20
After-tax target equity IRR (%)	7.5%	8.50%

Summary of Response* to Data Request:
Commercial Solar (251 to 999 kW)

**An empty cell represents the absence of a data response.*

	Commercial Solar		
	2015 Input	Response (1)	Response (2)
	500 kW	500 kW	500 kW
Production & Cost			
Expected Annual Average Net capacity factor, (%)	13.59%	13.75%	
Total Project Cost ($/kW$_{DC}$), excluding Interconnection Cost	$2,590	$2,520	$2,650
Interconnection cost ($/kW)	$86	$112	$20
O&M expenses ($/kWDC-yr), Yr 1 (excluding those listed below)	$15	$12	$20
Insurance, Yr 1, (provide as % of total project cost, or in $/yr)	0.25%	0.27%	0.57%
Project Management, Yr 1 ($/yr)	$3,300	$2,500	
Land Lease, Yr 1 ($/yr)	$6,000 with 2% esc.	$12,500 fixed	$10,000
Annual average escalation rate for O&M expenses (%)	2%	3%	3%
Property Tax, Starting Basis	80.00%	80.00%	PILOT Assumption - $5,000/MW
Property Tax, Annual Adjustment	-5.00%	-5.00%	
Property Tax, Basis Floor	30.00%	30.00%	
Decommissioning Reserve? If yes, how much?	$0	$5,000	
Inverter Replacement Year		20	12
Inverter Replacement, $/kW in year replaced	$0	$150	$140
Permanent Financing			
Debt/Equity (D/E) ratio	50%/50%	55%/45%	
Debt term (years)	18	15	
Interest rate on debt (%)	6.0%	6.25%	
Min. Debt Service Coverage Ratio	1.00	1.20	
After-tax target equity IRR (%)	7.0%	8.00%	10-12%

Summary of Response* to Data Request:
Large Solar (1 to 5 MW)

**An empty cell represents the absence of a data response.*

	Large Solar		
	2015 Input	**Response (1)**	**Response (2)**
	1,500 kW	**1,500 kW**	**1,500 kW**
Production & Cost			
Expected Annual Average Net capacity factor, (%)	14.18%	14.10%	
Total Project Cost ($/kW$_{DC}$), excluding Interconnection Cost	$1,996	$2,075	$2,000
Interconnection cost ($/kW)	$155	$167	$53
O&M expenses ($/kWDC-yr), Yr 1 (excluding those listed below)	$15	$11	$16
Insurance, Yr 1, (provide as % of total project cost, or in $/yr)	0.25%	0.27%	0.75%
Project Management, Yr 1 ($/yr)	$10,000	$7,500	
Land Lease, Yr 1 ($/yr)	$18,000 with 2% esc.	$22,500 with 2% esc.	$30,000
Annual average escalation rate for O&M expenses (%)	2%	3%	3%
Property Tax, Starting Basis	80.00%	80.00%	PILOT Assumption - $5,000/MW
Property Tax, Annual Adjustment	-5.00%	-5.00%	
Property Tax, Basis Floor	30.00%	30.00%	
Decommissioning Reserve? If yes, how much?	$0	$15,000	
Inverter Replacement Year		20	12
Inverter Replacement, $/kW in year replaced	$0	$150	$120
Permanent Financing			
Debt/Equity (D/E) ratio	50%/50%	55%/45%	
Debt term (years)	18	15	
Interest rate on debt (%)	6.0%	6.0%	
Min. Debt Service Coverage Ratio	1.00	1.20	
After-tax target equity IRR (%)	7.0%	8.0%	8-10%

Summary of Response* to Data Request:
Wind I (1 to 2.99 MW)

**An empty cell represents the absence of a data response.*

	Wind I	
	2015 Inputs	Response (1)
	1.65 MW	1.65 MW
Production & Cost		
Expected Annual Average Net capacity factor, (%)	21%	19%
Total Project Cost ($/kW$_{DC}$), excluding Interconnection Cost	$3,200	$3,700
Interconnection cost ($)	$107	$400
O&M expenses ($/kW$_{DC}$-yr), Yr 1 (excluding those listed below)	$25	$40
Project Management, Yr 1 ($/yr)	Included in fixed O&M	
Land Lease, Yr 1 ($/yr)	$52,000 with 2% esc.	
Permanent Financing		
If ITC was available in lieu of PTC, which would you elect?		ITC
ITC Utilization (%)	75%	
Debt/Equity (D/E) ratio PTC	70%/30%	
Debt/Equity (D/E) ratio ITC	60%/40%	
Debt/Equity (D/E) ratio w/o ITC or PTC	70%/30%	
Debt term (years)	18	15
Interest rate on debt (%)	6.50%	
Lender's fee (% of loan amt)	2.25%	
Avg. Debt Service Coverage Ratio	1.45	1.3
Min. Debt Service Coverage Ratio	1.00	
After-tax target equity IRR (%)	10%	

Summary of Response* to Data Request:
Wind II & III (3 to 5 MW)

**An empty cell represents the absence of a data response.*

	Wind II		Wind III (New Category)
	2015 Inputs	Response (1)	Response (1)
	3.3 MW	3.3 MW	4.95 MW
Production & Cost			
Expected Annual Average Net capacity factor, (%)	21%	19%	19%
Total Project Cost ($/kW) excluding Interconnection Cost	$3,700	$4,000	$3,700
Interconnection cost ($/kW)	$136	$800	$1,200
O&M expenses ($/kW-yr), Yr 1 (excluding those listed below)	$25	$35	$35
Project Management, Yr 1 ($/yr)	Included in fixed O&M		Included in fixed O&M
Land Lease, Yr 1 ($/yr)	$105,000 with 2% esc.		$156,000 with 2% esc.
Permanent Financing			
If ITC was available in lieu of PTC, which would you elect?		ITC	ITC
ITC Utilization (%)	75%		75%
Debt/Equity (D/E) ratio PTC	70%/30%		70%/30%
Debt/Equity (D/E) ratio ITC	60%/40%		60%/40%
Debt/Equity (D/E) ratio w/o ITC or PTC	70%/30%		70%/30%
Debt term (years)	18	15	15
Interest rate on debt (%)	6.50%		6.50%
Lender's fee (% of loan amt)	2.25%		2.25%
Avg. Debt Service Coverage Ratio	1.45	1.3	1.3
Min. Debt Service Coverage Ratio	1.00		1.0
After-tax target equity IRR (%)	10%		10%

Summary of Response* to Data Request:
AD II (501 kW to 1 MW)

**An empty cell represents the absence of a data response.*

	AD II	
	2015 Inputs	**Response (1)**
	750 kW	**750 kW**
Production & Cost		
Station Service/Parasitic Load	15%	20%
Total installed cost ($/kW), excl. Interconnection Cost	$10,000	$11,750
Typical Interconnection cost ($)	$275	$300
Fixed O&M expenses ($/kW-yr), Yr 1 (excluding those below)	$550	$610
Variable O&M (¢/kWh), Yr 1 (excluding those listed below)	2.0	2.2
Decommissioning Reserve? If yes, how much?	-	TBD
Capital Expenditures During Operations, Expense Year		2 - 20
Capital Expenditures During Operations, $/kW in Expense Year	-	$81.35
Permanent Financing		
If ITC was available in lieu of PTC, which would you elect?		ITC
Debt/Equity (D/E) ratio w/o ITC or PTC	70%/30%	60%/40%
After-tax target equity IRR (%)	10%	12-16%

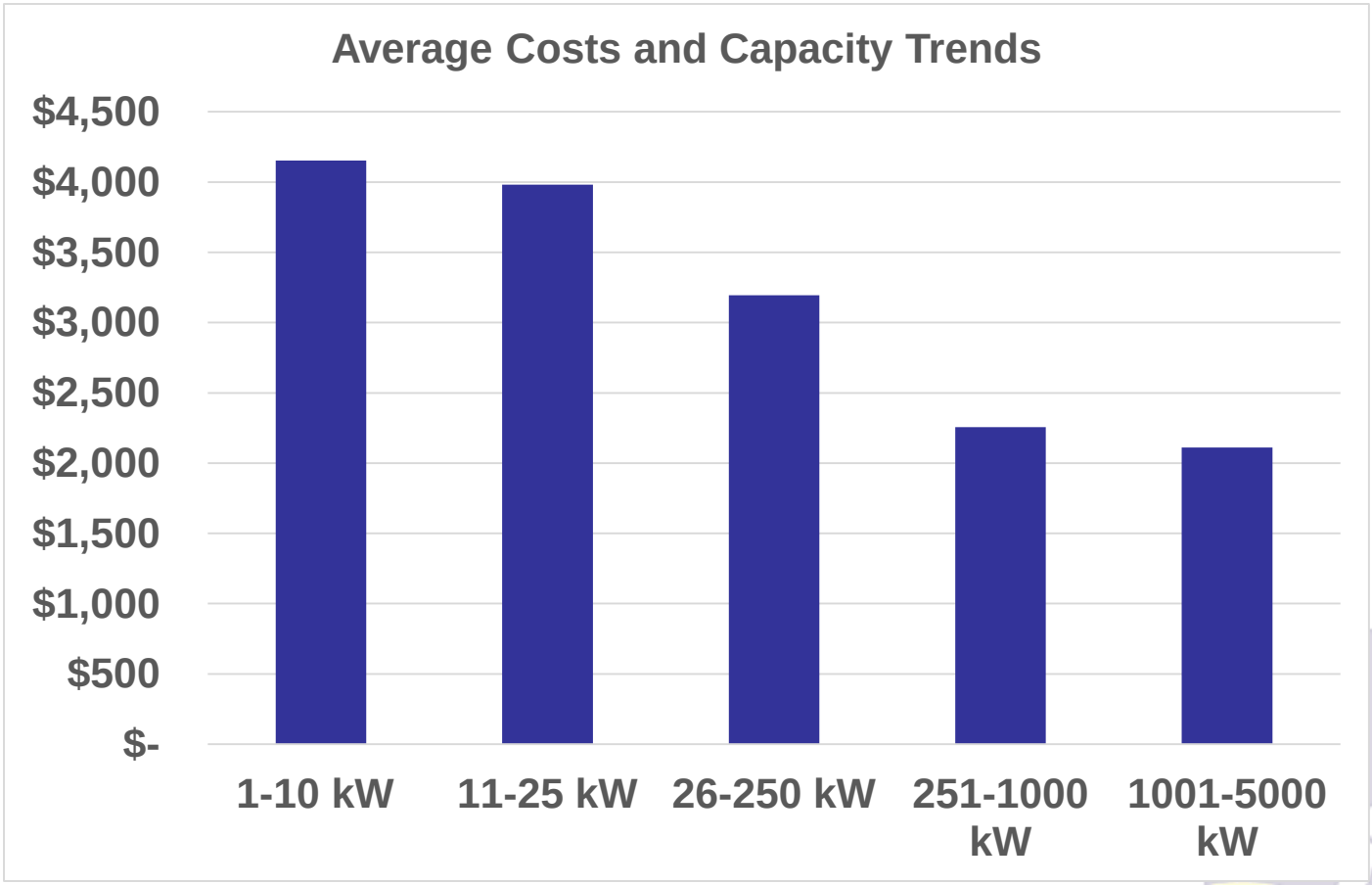
SUPPLEMENTAL RESEARCH

SOLAR

Supplemental Research

- Conducted in parallel to the Data Request
- Phone interviews with 2 solar installers
- Numerous data sources were consulted, including:
  - Past (2014) Distributed Generation Enrollment project data
  - Rhode Island Renewable Energy Fund project data
  - Production and project information contained in the Mass SREC database
  - LBNL's "Tracking the Sun" data, for RI, MA, CT, NY NH, VT,NJ,MD
  - NYSERDA Project information from Incentive Database
  - CT Green Bank Residential Incentive Program Data
  - SEIA and NREL Cost Projections and Market Data

Capacity and Cost Trends*



*Including Interconnection Costs

*Draws from RI REF and RI DG SO Program Data for 2014-Q2 2015

Small Solar Installed Cost Research

Residential 1-10 kW*

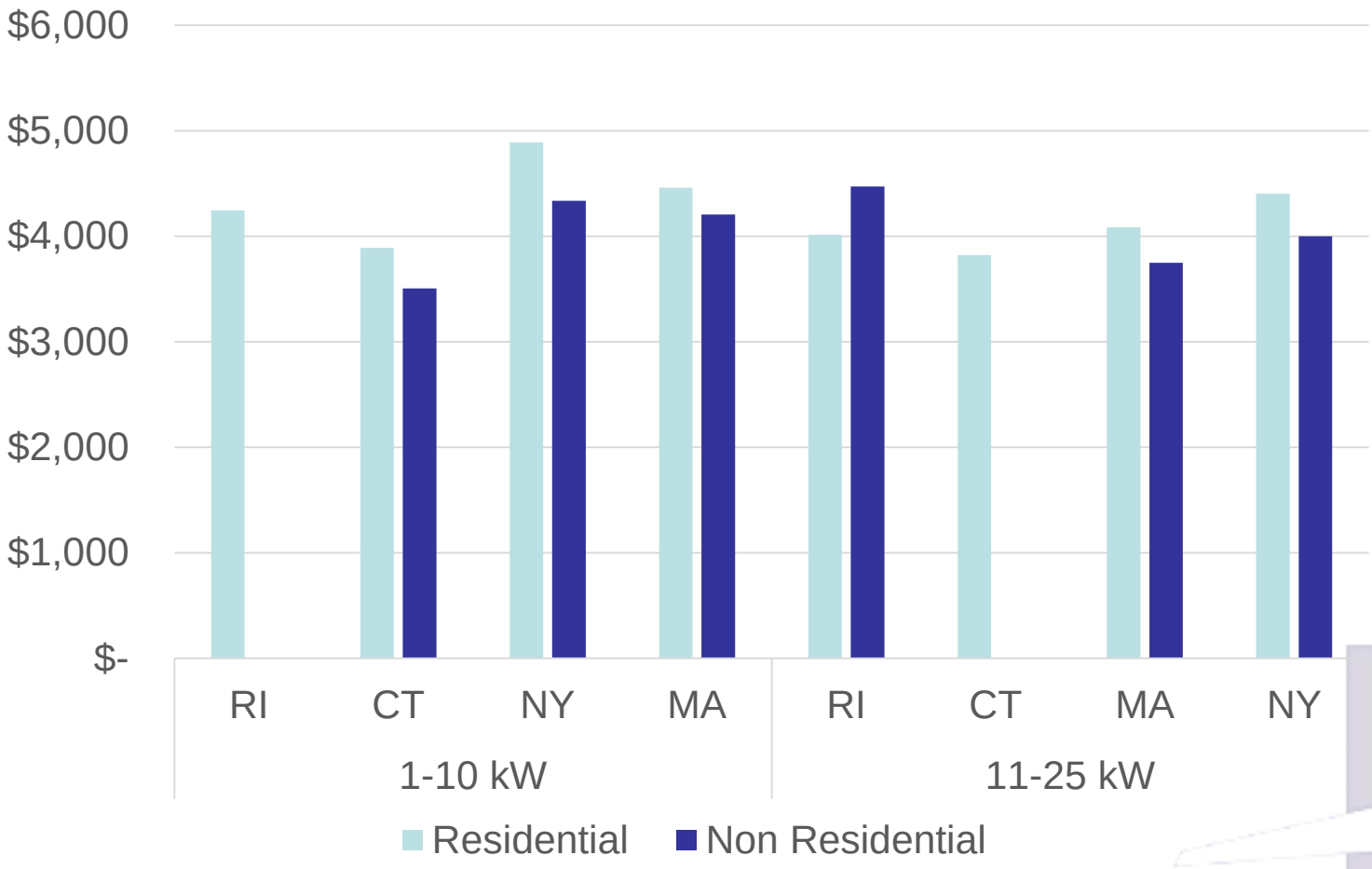
$ 4,152	$ 4,856	$ 4,454	$ 4,789
Average of REF Data Applications received in the last 12 months	Average of non-3rd-party-owned Mass SREC last 12 months	CT 1-10kW CEFIA Data	NYSERDA 1-10kW Last 12 Months

Non- Residential 1-10 kW

	Massachusetts	New Jersey	New York	New Hampshire	Vermont	Maryland
Average	$4,205	$3,549	$3,560	$3,367	$3,987	$3,080
Count	487	16	67	8	2	3

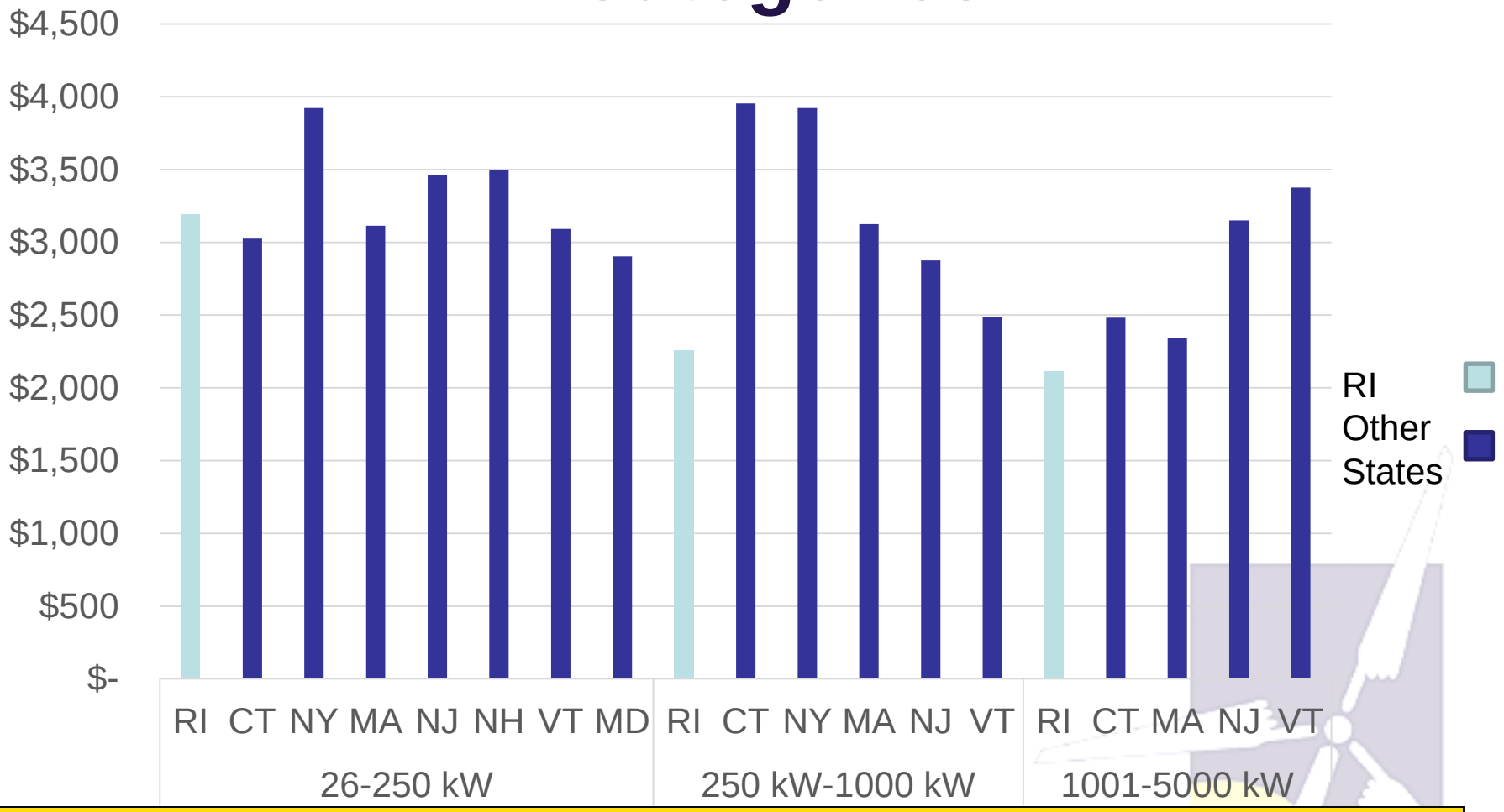
**No significant difference between Rhode Island and Connecticut and NYSERDA averages. (t-test, p=.05)*

Small Solar I+II Cost Comparison



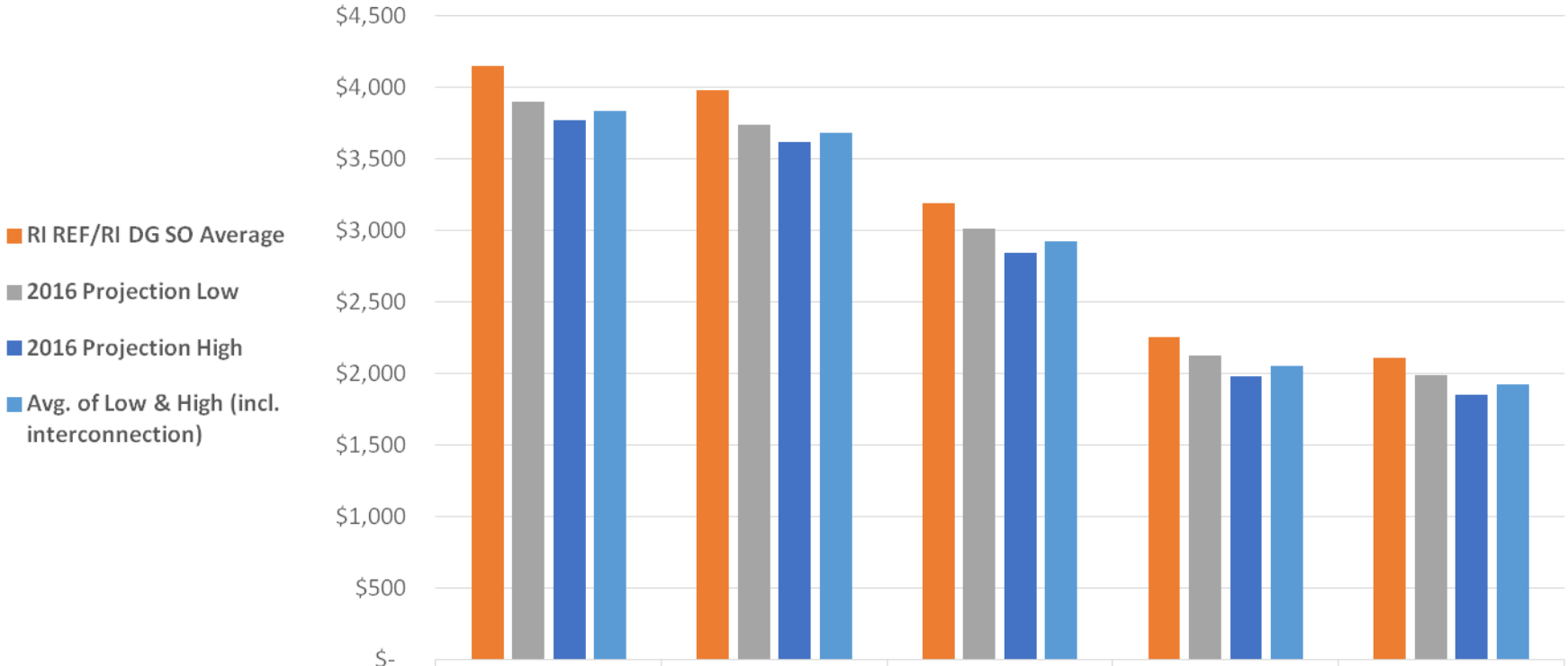
* Figures drawn from LBNL's 2014 Tracking the Sun Data, disaggregated into residential and non-residential. States with no data in a particular size category had no installations in the size class in 2014.

Installed Cost Trends – Larger Size Categories*



*Including Interconnection Costs
*Draws from RI DG SO Program Data and LBNL's Tracking the Sun Data

2016 Projections*



	RI, Residential 1-10	RI 11-25	RI, 26-250	RI, 251-1000	RI, 1001-5000
RI REF/RI DG SO Average	$4,152	$3,981	$3,194	$2,256	$2,112
2016 Projection Low	$3,903	$3,742	$3,012	$2,127	$1,992
2016 Projection High	$3,775	$3,619	$2,843	$1,976	$1,850
Avg. of Low & High (incl. interconnection)	$3,839	$3,680	$2,927	$2,052	$1,921

* -Low Cost reduction Scenario based on NREL's 2020 Evolution scenario, which reflects technology advancements as usual
-High cost reduction scenario extends 2014 observed price drops from SEIA's market research in residential, commercial, and utility-scale ground mount markets
*Includes data from RI REF, and RI DG SO Programs for 2014-Q2 2015

Interconnection Cost Analysis

Massachusetts and Rhode Island Solar Interconnection Costs		
	Number of Projects	Average Cost ($/kW DC)
Small Solar I <=10	0	N/A
Small Solar II <=25	0	N/A
Medium Solar	201	$11
Commercial Solar	112	$52
Large Solar	87	$110

Rhode Island Solar Interconnection Costs		
	Number of Projects	Average Cost ($/kW DC)
Small Solar I <=10	0	N/A
Small Solar II <=25	0	N/A
Medium Solar	11	$47
Commercial Solar	13	$103
Large Solar	4	$95

**Based on National Grid Data, excludes projects assumed to require safety equipment related to islanding (i.e. DTT, 3Vo, etc.)*

Proposed Installed Cost*

Class	Small Solar I (1-10 kW)	Small Solar II (11-25 kW)	Med. Solar (26-250 kW)	Comm. Solar (251-1,000 kW)	Lrg Solar (1-5 MW)
Historic Cost	$ 4,152	$ 3,981	$ 3,194	$ 2,256	$ 2,112
Avg. Size (kW)	6	14	72	527	1,218
Source	Average of REF Data	Average of REF Data	Average of DG Pilot Bid Data	Average of DG Pilot Bid Data	Average of DG Pilot Bid Data
2016 Cost	$ 3,839	$ 3,680	$ 2,927	$ 2,052	$ 1,921

- Installations after 7/31/2014
- Cost data is in $/kW of Installed Capacity, DC
- No significant difference between Rhode Island small solar prices and Connecticut and New York. Other datasets were not large enough to perform the same statistical test, but prices trends are similar.

*Including Interconnection Costs

Additional Solar Analysis & Comments

- **Inverter Replacement**
  - Research suggests that inverter insurance costs are not generally included in installed cost or O&M cost estimates.
  - A maintenance reserve for inverter replacement should be established and used to fund inverter replacement when failure occurs.
  - Extended inverter warranties are available but can be cost prohibitive.

- **Not-for-Profit installations**
  - "We've done non-profit work; the price per watt doesn't change, but ability to capture the tax credit does." [*We'll come back to this point later.*]
  - "Funders for non-profit systems are often non-profits themselves with no tax appetite."
  - "The market needs leasing or financing structures for smaller non-profits."
  - "We've had trouble finding TPO or financing for smaller projects."
- **State Tax Credit**
  - A state tax credit (maximum $3,750) is applied to the Ceiling Price calculation for all 3rd party-owned residential systems [see next slide].

Additional Analysis: State Tax Credit

- Eligibility: *Corporations* are eligible to receive a corporate tax credit for *ownership* of a PV system on a residential property.
  - Based on total installed cost
  - Minimum module size of twenty-four (24) square feet
  - Since the corporate entity must own the project, community-shared solar or other arrangements where the project (or portions thereof) are owned by individuals and not by a corporate third-party are not eligible.
  - See Chapter 44-57: Residential Renewable Energy System Tax Credit

- Value of Tax Credit:
  - The lesser of 25% of system cost or $3,750

WIND

Wind Production Data

- Source: MassCEC, Production Tracking System
  - 2014 and/or partial historic production data provided for 10 MA wind projects between 1 and 5 MW
  - Curtailment, major mechanical issues, or lack of data prevents the inclusion of 7 additional projects
  - Historic production includes at least 12 months of data
    - Assume first 6 to 12 months should always be filtered out due to standard start-up issues and turbine break-in period
  - Updated historic production requested from MassCEC

- Source: Operating & Proposed RI Projects

Wind Production Data
(MassCEC Production Tracking System)

Project	Location (MA)	Net capacity factor (2014)	Net capacity factor, pre-2014 available data
MA Military Reservation #1 (US Air Force)	Bourne & Falmouth (Cape Cod)	N/A	~23%
Scituate Wind LLC*	Scituate (Southeast)	~20%*	~28%
Ipswich Municipal Light Plant	Ipswich (Northeast)	~25%	~25%
NOTUS Clean Energy	Falmouth (Cape Cod)	~34%	~32%
Jiminy Peak	Hancock (Western)	~34%	~32%
Hull 2	Hull (Southeast)	N/A	~26%
Lightolier	Fall River (Southeast)	~17%	N/A
Fairhaven Wind LLC	Fairhaven (Southeast)	~20%	~19%
Town of Kingston	Kingston (Southeast)	~21%	~20%
MA Military Reservation #2 & #3 (US Air Force)	Bourne & Falmouth (Cape Cod)	N/A	~26%

*Missing one month of production data

Projects Not Included in Dataset

Project	Location (MA)	Reason for Exclusion
MWRA Deer Island	Winthrop	Tower height restriction due to proximity to Logan Airport
Falmouth Wind 1 & 2	Falmouth	Curtailed operations imposed by pending litigation
MWRA DeLauri Pumping Station	Charlestown	Production data not available; requested from MassCEC
Templeton Municipal Light Plant	Templeton	Inconsistent operating history
Princeton Municipal Light Plant	Princeton	Inconsistent operating history
Mount Wachusett Community College	Gardner	Production data not available; requested from MassCEC
No Fossil Fuels LLC	Kingston	Production data not available; requested from MassCEC

Wind Production Data
(Operating & Proposed RI Projects)

Operating Project	Location (RI)	Net capacity factor (2014)	Net capacity factor (2013)
NK Green	North Kingstown	17.02%	19.75%
Narragansett Bay Commission	Field's Point	19.3%	16.3%
Portsmouth HS	Portsmouth	NA	22.2%*

Proposed Project	Location (RI)	P90 capacity factor	P50 capacity factor
Coventry 1	Coventry	19.6%	23.8%
Coventry 2	Coventry	19.1%	23.9%
Coventry 3	Coventry	21.0%	26.0%
Coventry 4	Coventry	20.1%	24.4%
Coventry 5	Coventry	21.3%	25.9%
Coventry 6	Coventry	19.5%	23.7%
Average		**20.1%**	**24.6%**

** Based on 2011 production.*

Interconnection Cost Research*

Massachusetts and Rhode Island Wind Interconnection Costs		
Ceiling Price Category	Number of Projects	Average Cost ($/kW)
N/A	5	$112
Wind I	5	$93
Wind II	1	$61
Wind III	0	N/A

Rhode Island Wind Interconnection Costs		
Ceiling Price Category	Number of Projects	Average Cost ($/kW)
N/A	3	$61
Wind I	1	$120
Wind II	0	N/A
Wind III	0	N/A

**Based on National Grid Data, excludes projects assumed to require safety equipment related to islanding (i.e. DTT, 3Vo, etc.)*

Additional Wind Evaluation

- **Production and Capacity Factor**
  - Definitions:
    - P50 = 50% probability of annual production ≥ a specified value (e.g. 2,000).
    - P90 = 90% probability of annual production ≥ a specified value (e.g. 1,600).

      Because of their relative probability, P90 is always < P50.
  - Applicability:
    - P50 is the estimate of long-term average production, and is appropriate for evaluating policy design and the central estimate of equity returns (of course, equity returns can also be evaluated at P90 for a near “worst case”).
    - P90 is appropriate for evaluating a project’s annual cash flow risk (as opposed to long-term return potential) and is (almost) always used by lenders to calculate the size of loan that a project can sustainably maintain.
- **Reserves**
  - While long-term average production expectations (P50) are appropriate for setting policy, the impact of P90 estimates on project financing options, capital stack, and debt service reserve requirements should not be under-estimated.
  - As such, increased reserve requirements are taken into account in this analysis.

ANAEROBIC DIGESTION

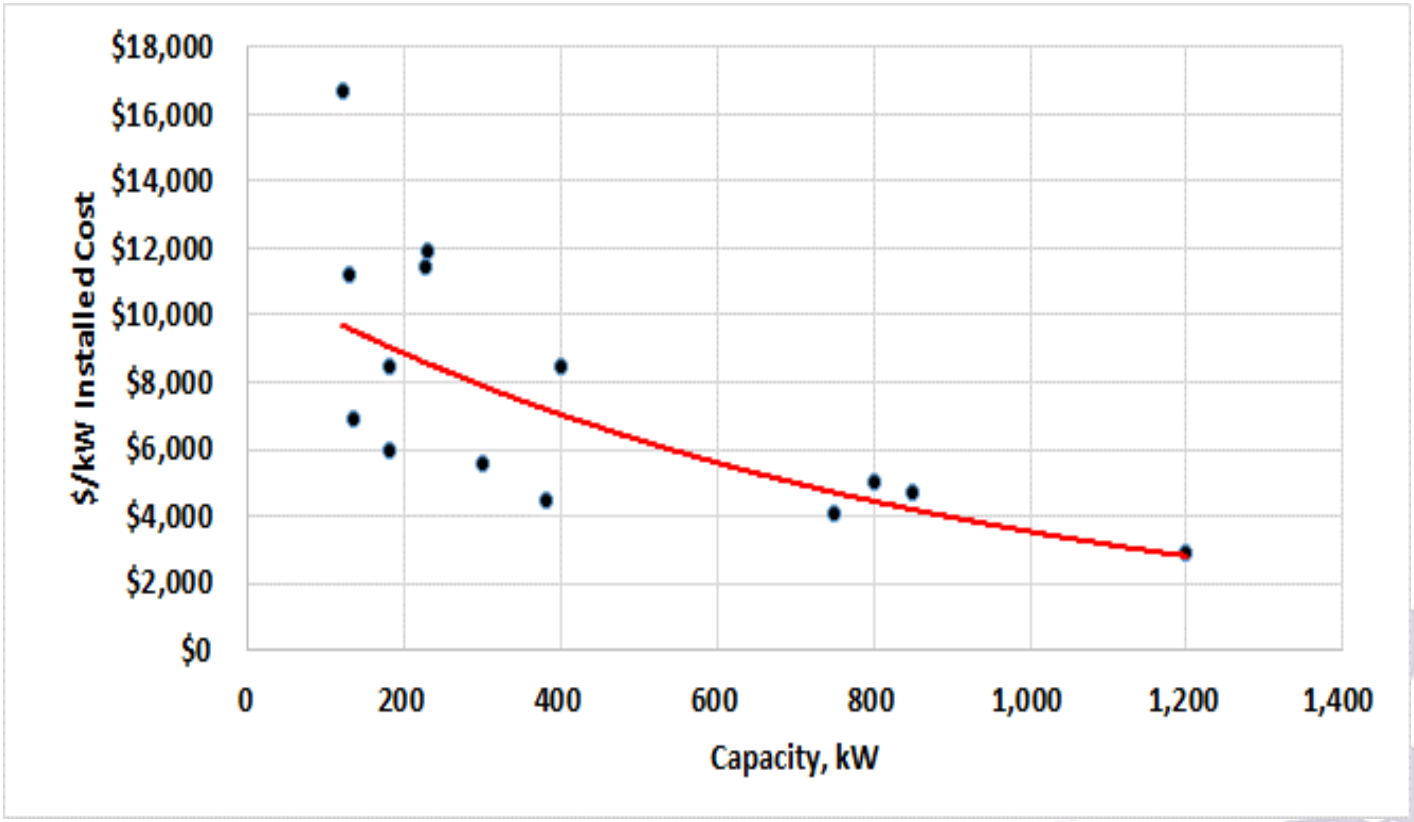
AD Installed Cost Review & Data Extrapolation to 2016

Project Name	State	Capacity (kW)	Installation Year	Est.* Cost per kW in Installation Year	Installed Cost** per kW in 2016
Auora Ridge	NY	400	2009	$6,916	$8,506
Central Marin F2E	CA	750	2013	$3,711	$4,055
Clover Hill	WI	300	2008	$4,400	$5,574
Gordondale	WI	135	2001	$4,416	$6,880
Holsum Elm Dairy	WI	1200	2007	$2,200	$2,871
Hunter haven	WI	130	2005	$8,123	$11,244
Maxwell farms	VT	225	2007	$8,800	$11,482
Norswiss Farms	WI	848	2006	$3,502	$4,707
Patterson Farms	NY	180	2008	$4,744	$6,009
Pennwood Farms	PA	180	2011	$7,333	$8,501
Ringler Energy LLC	OH	800	2012	$4,469	$5,030
Sunny Knoll Farms	NY	230	2006	$8,854	$11,899
Twin Birch Phase 1	NY	120	2009	$13,560	$16,677
Zuber Farms	NY	380	2009	$3,662	$4,504

** Researched cost estimate increased by 10% to take account for transaction-related soft costs.*

*** 3% annual escalation from installation year to 2016.*

ANAEROBIC DIGESTION CHP SYSTEM INSTALLED COST VERSUS GENERATING CAPACITY



Interconnection Cost Analysis*

Rhode Island Anaerobic Digestion Interconnection Costs		
Ceiling Price Category	Number of Projects	Average Cost ($/kW AC)
AD I	1	$20
AD II	0	N/A

**Based on National Grid Data, excludes projects assumed to require safety equipment related to islanding (i.e. DTT, 3Vo, etc.)*

Additional Comments

- **Anaerobic Digestion**
  - CT Green Bank working w/ several 1-1.5 MW projects in financing stage
  - Installed costs are approximately $20 million within this size range ($13,000 - $20,000 per kW)
  - Even with disposal mandates, there is some concern about feedstock adequacy with facilities of this size.
  - More data will be available in 2016
- **Hydro**
  - Market is mature, with limited (site-specific) opportunities and long lead times
  - No incremental cost or performance data available for 2016 CP analysis
- **Programmatic feedback**
  - The net metering program really only needed a few forms, which were simple for homeowner
  - Paperwork needs to be streamlined - there are multiple forms with online, phone and notary requirements.
  - Need to reduce burden to get projects approved.

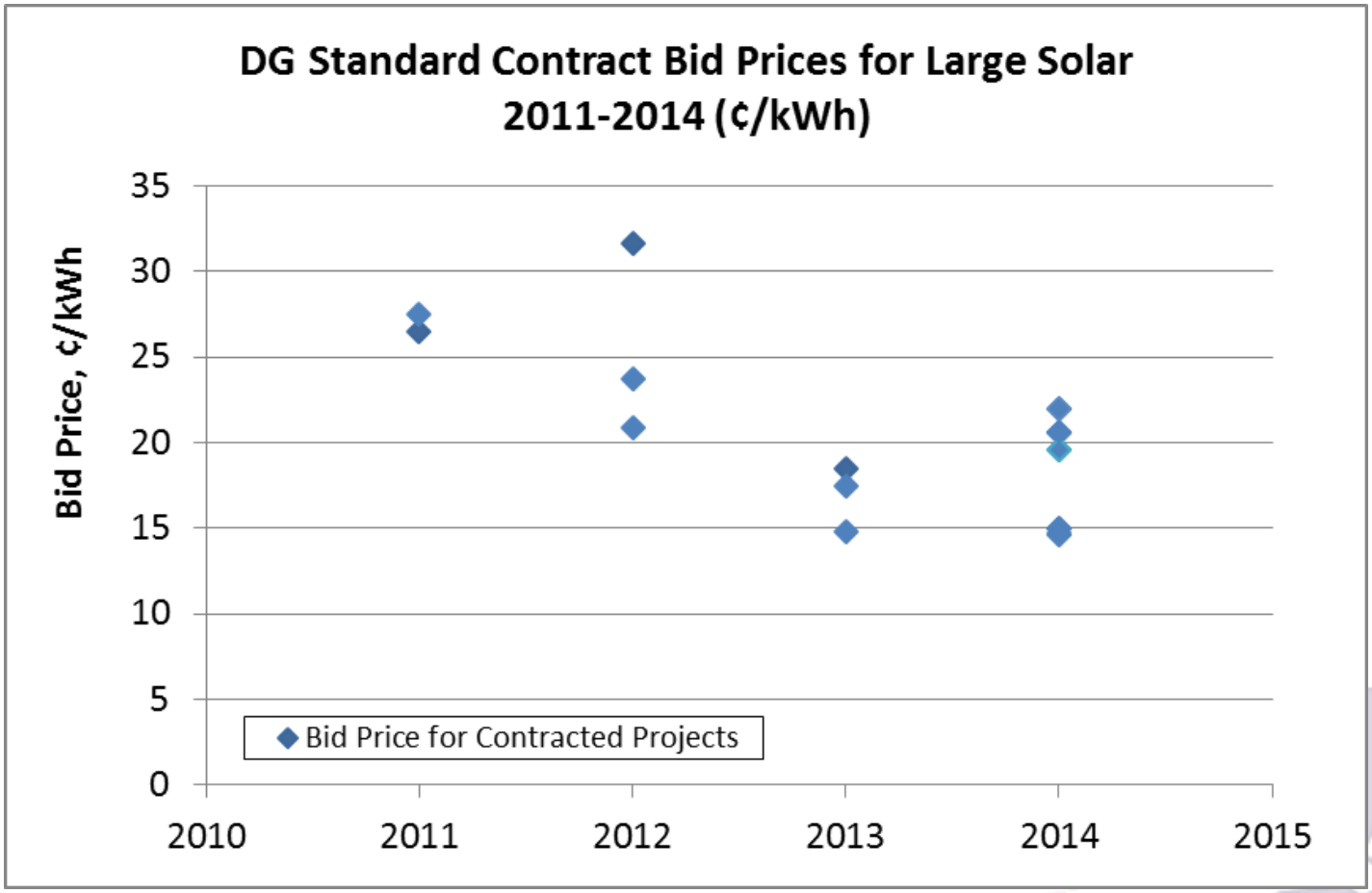
REGIONAL BENCHMARKING & DG SC BID DATA

VT Standard Offer 2015 Bid Prices: SOLAR

Project Name	Project Size (kW)	Bid Price* ($/kWh)
Triland BlueWave Pownal	2,100	$0.1096
Triland BlueWave Williamstown	2,100	$0.1097
Slang Creek Solar	2,100	$0.1147
Triland BlueWave Hartford	2,100	$0.1168
Highgate Solar 1 Project	2,200	$0.1169
Cold River Solar 1 Project	2,200	$0.1169
Weybridge Solar 1 Project	2,200	$0.1169
Cristofe Luis x Green Power Solutions	1,250	$0.1225
Highgate Solar 1 Project (Alt. location)	2,200	$0.1229
Weybridge Solar 2 Project	2,200	$0.1229
Hunt Road Solar	2,200	$0.1245
Cold River Solar 2 Project	2,200	$0.1249
Lyndonville Solar 1	485	$0.154
Lyndonville Solar 2	500	$0.155

** Note that the VT SO Program offers 25-year fixed price contracts, compared to 20 years in RI.*

RI DG Standard Contract Bid Price History



VT SPEED 2015 Solar Bid Prices (NON-SOLAR)

Food Waste

Project Name	Project Size (kW)	Bid Price (/kWh)
Brattleboro Organic Energy	300	$0.2080

Wind

Project Name	Project Size (kW)	Bid Price (/kWh)
Highgate Wind 1 Project	100	$0.2520
Highgate Wind 2 Project	100	$0.2520
Highgate Wind 3 Project	100	$0.2520
Highgate Wind 4 Project	100	$0.2520
Tesla Wind	36	$0.2530
Baily Hill Wind	24	$0.2530
Danby Wind Farm	96	$0.2530
Hedgehog Hill Wind B	96	$0.2530

Hydro

Project Name	Project Size (kW)	Bid Price (/kWh)
Pownal Tannery	1,100	$0.1226

Evaluation of Regional Bid Price History

- Ceiling prices are intended to be designed to represent cost-effective, yet replicable, projects
- Ceiling prices are not designed around individual projects, bids, outliers, or unique circumstances
- This evaluation recognizes state-specific differences (within the Northeast Region) with respect to:
  - Construction cost, including labor
  - Maintenance costs
  - Property taxes
- Market maturity (duration & deployment) must also be considered

MODELED PARAMETERS: SOLAR

SOLAR: Cost & Production Inputs

Modeled Parameters

		Small Solar I Resi (1-10 kW)	Small Solar I Comm (1-10 kW)	Small Solar II (11-25 kW)	Medium Solar (26-250 kW)	Commercial Solar (251-1,000 kW)	Large Solar (1-5 MW)
Nameplate Capacity	kW	5		25	140	500	**2,000**
Capacity Factor		13.49%	13.49%	13.49%	13.45%	13.59%	14.18%
Annual Degradation	%	0.5%					
Cost, Less Interconnection	$/kW	**$3,839**		**$3,680**	**$2,880**	**$1,949**	**$1,828**
Interconnection	$/kW	$0			**$47**	**$103**	**$195**

Blue = change from 2015 value.

Ongoing Cost Assumptions

Modeled Parameters

		Small Solar I Resi (1-10 kW)	Small Solar I Comm (1-10 kW)	Small Solar II (11-25 kW)	Medium Solar (26-250 kW)	Commercial Solar (251-1,000 kW)	Large Solar (1-5 MW)
Fixed O&M Expense, Yr 1	$/kW-yr	$15.00					
O&M Cost Inflation	%	2%					
Insurance, Yr 1 (% of Total Cost)	%	0.00%				0.25%	
Management Yr 1	$/yr	**$150**			$500	$3,300	$10,000
Land Lease	$/yr	**$0**				**$6,000**	**$24,000**

Blue = change from 2015 value.

Financing Assumptions

Modeled Parameters

		Small Solar I Resi (1-10 kW)	Small Solar I Comm (1-10 kW)	Small Solar II (11-25 kW)	Medium Solar (26-250 kW)	Commercial Solar (251-1,000 kW)	Large Solar (1-5 MW)
% Debt	%	0%	50%	60%	50%		
Debt Term	yrs	N/A	13/18	18			
Interest Rate on Term Debt	%	N/A	6.5%			6.0%	
Lender's Fee (% of total borrowing)	%	N/A	2.25%				
Required Minimum Annual DSCR		N/A	1.00				
Required Average DSCR		N/A	1.35				
Target After-Tax Equity IRR	%	6.0%	8.0%			7.5%	7.0%
Reserve Requirement	$	$0	$0	$0	$0	$0	$0

Blue = change from 2015 value.

Addition of Ceiling Prices for Not-for-Profit & Affordable Housing

- **Why**: not-for-profit and affordable housing categories have been under-represented in the REG program.
- **How**: Since Ceiling Prices are cost-based, CP differentiation proposed based on ownership.
  - *Installed* costs are not expected to differ based on either the type of entity owning the project or the economic means of a tenant or business owner.
  - The *levelized cost of energy* (LCOE) will vary between owner types, however, based on the ability to make productive use of all available incentives (e.g. the Federal Investment Tax Credit).
  - The analysis explores differential Ceiling Prices for selected solar projects owned by not-for-profit entities.
- As a matter of policy implementation, the DG Board could also recommend to the PUC that non-profit Ceiling Prices be extended to owners of projects located on, or for the benefit of, affordable housing owned by for profit entities ***if*** the incremental benefits are effectively passed through to tenants.

MODELED PARAMETERS: WIND

Production and Capital Cost Assumptions

Modeled Parameters

		Wind I	Wind II	Wind III
Nameplate Capacity	kW	1,650	3,300	**4,950**
Capacity Factor	%	21%		
Annual Degradation	%	0.0%		
Generation Equipment	$/kW	$3,200	$3,100	**$3,000**
Interconnection	$/kW	**$241**	**$181**	**$160**

Blue = change from 2015 value.

Ongoing Cost Assumptions

Modeled Parameters

		Wind I	Wind II	Wind III
Fixed O&M Expense, Yr 1	$/kW-yr	$25.00		
O&M Cost Inflation	%	2%		
Insurance, Yr 1 (% of Total Cost)	%	0.60%		
Management Yr 1	$/yr	Included in O&M		
Land Lease	$/yr	$52,500	$105,000	**$157,500**

Blue = change from 2015 value.

Financing Assumptions

Modeled Parameters

		Wind I	Wind II	Wind III
% Debt	%	70%		
Debt Term	years	18		
Interest Rate on Term Debt	%	6.5%		
Lender's Fee (% of total borrowing)	%	2.25%		
Required Minimum Annual DSCR		1.00		
Required Average DSCR		1.45		
Target After-Tax Equity IRR	%	10%		
Reserve Requirement	$	6 months of debt service		

MODELED PARAMETERS:
ANAEROBIC DIGESTION

PROJECT PERFORMANCE ASSUMPTIONS

Modeled Parameters

		Anaerobic Digestion I	Anaerobic Digestion II
Generator Nameplate Capacity	*kW*	**325**	**725**
Biogas Consumption per Day	*cubic feet/day*	**120,066**	**267,840**
Energy Content per Cubic Foot	*BTU/cubic foot*	**600**	
Heat Rate	*BTU/kWh*	**8,928**	
Availability	*%*	**92%**	
Station Service (Parasitic Load)	*%*	**20%**	
Annual Production Degradation	*%*	**0%**	
Project Useful Life	*years*	**20**	

Blue = change from 2015 value.

CAPITAL, INTERCONNECTION AND O&M COSTS

Modeled Parameters

		Anaerobic Digestion I	Anaerobic Digestion II
Generation Equipment	*$/kW*	**$10,000**	**$10,000**
Interconnection Costs	*$/kW*	**$150**	
Fixed O&M Expense	*$/kW-yr*	**$600**	
Variable O&M Expense	*¢/kWh*	**2.00**	
O&M Cost Inflation	*%*	**2%**	

Blue = change from 2015 value.

ONGOING EXPENSE ASSUMPTIONS

Modeled Parameters

		Anaerobic Digestion I	Anaerobic Digestion II
Insurance, Yr 1 (% of Total Cost)	*%*	**1.0%**	
Project Management Yr 1	*$/yr*	**$33,621**	**$75,000**
Water & Sewer Expenses	*$/yr*	**$0**	
Digestate Disposal Cost (if handled as an expense)	*$/ton*	**$0.00**	
Land Lease	*$/yr*	**$15,690**	**$35,000**

FINANCING ASSUMPTIONS

Modeled Parameters

		Anaerobic Digestion I	Anaerobic Digestion II
% Debt (% of hard costs) (mortgage-style amort.)	*%*	**60%**	
Debt Term	*years*	**18**	
Interest Rate on Term Debt	*%*	**7%**	
Lender's Fee (% of total borrowing)	*%*	**0%**	
Required Minimum Annual DSCR	*Ratio*	**1.00**	
Required Average DSCR	*Ratio*	**1.50**	
Target After-Tax Equity IRR	*%*	**10%**	
Other Closing Costs	*$*	**$0**	
Reserve Requirement	*$*	**$0**	

SUPPLEMENTAL REVENUE ASSUMPTIONS

Modeled Parameters

		Anaerobic Digestion I	Anaerobic Digestion II
Tipping Fee	*$/ton*	**$22.50**	
Quantity Received Each Year	*tons per year*	**10,000**	**22,308**
Digestate (if merchantable for additional revenue)	*$/gallon*	**$0**	

Blue = change from 2015 value.

MODELED PARAMETERS: HYDRO

Production and Capital Cost Assumptions

Modeled Parameters

		Hydro I	Hydro II
Nameplate Capacity	kW	150	500
Capacity Factor	%	40%	
Annual Degradation	%	0.0%	
Cost Excluding Interconnection	$/kW	$4,000	
Interconnection	$/kW	$100	

ONGOING EXPENSES

Modeled Parameters

		Hydro I	Hydro II
Fixed O&M Expense, Yr 1	$/kW-yr	**$13.00**	
O&M Cost Inflation	%	**3%**	
Insurance, Yr 1 (% of Total Cost)	%	**0.50%**	
Management Yr 1	$/yr	**$5,000**	**$15,000**
Land Lease	$/yr	**$2,500**	**$10,000**

FINANCING ASSUMPTIONS

Modeled Parameters

		Hydro I	Hydro II
% Debt	%	**50%**	
Debt Term	yrs	**18**	
Interest Rate on Term Debt	%	**6.5%**	
Lender's Fee (% of total borrowing)	%	**2.25%**	
Required Minimum Annual DSCR		**1.00**	
Required Average DSCR		**1.45**	
Target After-Tax Equity IRR	%	**10%**	
Reserve Requirement	$	**$0**	

MODELED PARAMETERS: ADDITIONAL ASSUMPTIONS, ALL TECHNOLOGIES

Incentives

- Solar:
  - 30% ITC for projects operational on or before 12/31/2016.
  - 10% ITC for commercially-owned projects on-line beginning 1/1/2017
  - No ITC for homeowner-owned projects on-line beginning 1/1/2017

Monetization	Res. 5 kW	Res./Com. 25 kW	140 kW	500 kW	1,500 kW
%	100%	100%	100%	90%	90%

- Wind, AD & Hydro
  - No PTC or ITC in lieu thereof unless project started construction on or before 12/31/2014
  - If available, wind = 100% of PTC face value; AD & hydro = 50% of face value

Monetization	Wind	AD	Hydro
ITC	75%	N/A	N/A
PTC	100%	100%	100%

- Benefit of Net Operating Loss at state level assessed both “as generated” and “carried-forward”. Proposed CPs are an average of these two results.
- No federal, state, local or other grants assumed.

Additional Assumptions

- COD achieved in 2016
- Project Useful Life:
  - Solar = 25 years
  - Wind & AD = 20 years
  - Hydro = 30 years
- Fed. Income Tax rate 35%; State rate 9%
- Property tax rate:
  - Solar & Hydro = statewide (straight) average, less outliers (Central Falls & North Providence) and towns with exemptions (Foster, North Smithfield & Smithfield) ($26.54/thousand)
  - Wind & AD = MW- and location-weighted average of awarded capacity ($20.19 and $18.91/thousand, respectively)
- *Assumed NEPOOL Membership costs either covered by NGRID as lead participant, or spread over many installations and therefore negligible*
- Market value of production (assumed revenue) post-contract = see next slide

Additional Assumptions:
Forecast of Market Value of Production

Project Year	Calendar Year	Market Value of Production (incl. energy, capacity & RECs) (cents/kWh)	
		Solar	Hydro
21	2035	13.84	13.02
22	2036	14.68	13.81
23	2037	15.57	14.65
24	2038	16.52	15.55
25	2039	17.56	16.52
26	2040		17.55
27	2041		18.62
28	2042		19.76
29	2043		20.97
30	2044		22.25

SUMMARY RESULTS

Draft Proposed Ceiling Prices, 2016 REG Program (1)

Technology	System Size	2016 Proposed CP w/ ITC 15 year Tariff Duration	2016 Proposed CP w/ o ITC 15 year Tariff Duration	2016 Proposed CP w/ ITC 20 year Tariff Duration	2016 Proposed CP w/o ITC 20 year Tariff Duration
Small Solar I, Resident Owned	1 to 10 kW (5)	**$34.05 (-18%)**	**$41.05 (-18%)**	**$30.75 (-19%)**	**$36.75 (-18%)**
Small Solar I, Resident Owned, No Property Tax	1 to 10 kW (5)	**$29.75**	**$26.75**	**$27.05**	**$33.05**
Small Solar I, Third Party Owned	1 to 10 kW (5)	**$28.15 (-25%)**	**$33.20 (-24%)**	**$24.60 (-25%)**	**$28.75 (-24%)**
Small Solar I, Third Party Owned, No Property Tax	1 to 10 kW (5)	**$23.95**	**$29.00**	**$22.35**	**$26.85**
Small Solar I, Non-Profit, & Affordable Housing	1 to 10 kW (5)	**$40.65**		**$37.05**	

See Appendix for approved 2015 ceiling prices

Draft Proposed Ceiling Prices, 2016 REG Program (2)

Technology	System Size	2016 Proposed CP w/ 30% ITC 20 year Tariff Duration	2016 Proposed CP w/ 10% ITC 20 year Tariff Duration
Small Solar II	11 to 25 kW (25)	**$26.15 (-12%)**	**$30.15 (-12%)**
Small Solar II, Non-Profit & Affordable Housing	11 to 25 kW (25)	**$32.65**	**$32.45**
Medium Solar	26 to 250 kW (140)	**$20.85 (-14%)**	**$25.40 (-14%)**
Medium Solar, Non-Profit & Affordable Housing	26 to 250 kW (140)	**$26.25**	**$26.15**
Commercial Solar	251 to 999 kW (500)	**$16.10 (-23%)**	**$19.05 (-23%)**
Large Solar	1 to 5 MW (2)	**$15.20 (-9%)**	**$17.85 (-8%)**

See Appendix for approved 2015 ceiling prices

Draft Proposed Ceiling Prices, 2016 REG Program (3)

Technology	System Size	2016 Proposed CP w/ ITC ILO PTC 20 year Tariff Duration	2016 Proposed CP w/ PTC 20 year Tariff Duration	2016 Proposed CP w/o PTC or ITC 20 year Tariff Duration
Wind I	1.5 to 2.99 MW (1.65)	**$19.95 (+8%)**	**$21.45 (+8%)**	**$24.45 (+8%)**
Wind II	3 to 5 MW (3.3)	**$19.10 (+5%)**	**$20.45 (+5%)**	**$23.45 (+5%)**
Wind III	3 to 5 MW (4.95)	**$18.50**	**$19.70**	**$22.65**

Technology	System Size	2016 Proposed CP w/ PTC 20 year Tariff Duration	2016 Proposed CP w /o PTC 20 year Tariff Duration
Anaerobic Digestion I	150 to 500 kW	**$20.80 (+3%)**	**$21.20 (+3%)**
Anaerobic Digestion II	501 kW to 1 MW	**$20.80 (+3%)**	**$21.20 (+3%)**
Hydro I	10 to 250 kW	**$19.45 (-2%)**	**$21.00 (-2%)**
Hydro II	251 kW to 1 MW	**$18.25 (-2%)**	**$19.75 (-2%)**

See Appendix for approved 2015 ceiling prices

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APPENDIX

Approved Ceiling Prices, 2015 REG Program (1)

Technology	System Size	**2015 CP** w/ ITC 15 year Tariff Duration	**2015 CP** w/ o ITC 15 year Tariff Duration	**2015 CP** w/ ITC 20 year Tariff Duration	**2015 CP** w/o ITC 20 year Tariff Duration
Small Solar I, Resident Owned	1 to 10 kW (5)	**$41.35**	**$49.85**	**$37.75**	**$45.05**
Small Solar I, Resident Owned, No Property Tax	1 to 10 kW (5)				
Small Solar I, Third Party Owned	1 to 10 kW (5)	**$37.60**	**$43.40**	**$32.95**	**$37.65**
Small Solar I, Third Party Owned, No Property Tax	1 to 10 kW (5)				
Small Solar I, Non-Profit, & Affordable Housing	1 to 10 kW (5)				

**Blank indicates a new ceiling price technology in 2016 with no 2015 ceiling price*

Draft Proposed Ceiling Prices, 2016 REG Program (2)

Technology	System Size	2015 CP w/ 30% ITC 20 year Tariff Duration	2015 CP w/ 10% ITC 20 year Tariff Duration
Small Solar II	11 to 25 kW (25)	**$29.80**	**$34.40**
Small Solar II, Non-Profit & Affordable Housing	11 to 25 kW (25)		
Medium Solar	26 to 250 kW (140)	**$24.40**	**$29.55**
Medium Solar, Non-Profit & Affordable Housing	26 to 250 kW (140)		
Commercial Solar	251 to 999 kW (500)	**$20.95**	**$24.65**
Large Solar	1 to 5 MW (2)	**$16.70**	**$19.40**

**Blank indicates a new ceiling price technology in 2016 with no 2015 ceiling price*

Draft Proposed Ceiling Prices, 2016 REG Program (3)

Technology	System Size	**2015 CP** w/ ITC ILO PTC 20 year Tariff Duration	**2015 CP** w/ PTC 20 year Tariff Duration	**2015 CP** w/o PTC or ITC 20 year Tariff Duration
Wind I	1.5 to 2.99 MW (1.65)	**$18.40**	**$19.85**	**$22.75**
Wind II	3 to 5 MW (3.3)	**$18.20**	**$19.45**	**$22.35**
Wind III	3 to 5 MW (4.95)			

Technology	System Size	**2015 CP** w/ PTC 20 year Tariff Duration	**2015 CP** w /o PTC 20 year Tariff Duration
Anaerobic Digestion I	150 to 500 kW	**$20.20**	**$20.60**
Anaerobic Digestion II	501 kW to 1 MW	**$20.20**	**$20.60**
Hydro I	10 to 250 kW	**$19.80**	**$21.35**
Hydro II	251 kW to 1 MW	**$18.55**	**$20.10**

**Blank indicates a new ceiling price technology in 2016 with no 2015 ceiling price*